

EFFECTS OF *CONDYLACTUS GIGANTEA* AND SUBSTRATE VARIABILITY ON HERBIVORY OF *THALASSIA TESTUDINUM*JESSICA E. VEYSEY, LINDA E. AUCOIN, JAMES A. MACINTOSH,
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Abstract: *Condylactis gigantea*, the giant sea anemone, is a common species in tropical coral reefs and nearby beds of turtle grass, *Thalassia testudinum*. Previous studies have shown that the powerful nematocysts of the anemone *Bunodeopsis antillensis* decrease the level of herbivory on turtle grass; *C. gigantea* may affect the level of herbivory on turtle grass in a similar manner. We tested for differences in herbivory based upon the proximity of *C. gigantea* to turtle grass blades in exposed rock terrain and homogeneous fields of turtle grass. Neither substrate type (rock or sand), contact with an anemone, nor the interaction of these factors significantly affected herbivory of the turtle grass blades. *C. gigantea* may not influence grass herbivory because its nematocysts are not potent enough to injure parrotfish and dissuade herbivory. *C. gigantea* may indirectly benefit by not increasing fitness of turtle grass in contact with its tentacles as shading from grass blades might inhibit the photosynthetic productivity of *C. gigantea*'s zooxanthellae.

Key Words: giant sea anemone, parrotfish, Scaridae, turtle grass

INTRODUCTION

Thalassia testudinum (turtle grass) is commonly found along Caribbean reefs where it can be heavily grazed by various species of the family Scaridae (parrotfishes; Stokes 1984). Parrotfish herbivory is reduced in the presence of *Bunodeopsis antillensis*, a small anemone with highly toxic nematocysts that lives on grass blade tips (Abram and Liebert 1994). *Condylactis gigantea*, the giant sea anemone, occurs both on Caribbean reefs and in nearby fields of turtle grass (Sterrer 1986). A large portion of its nutrients is derived from the photosynthetic byproducts of zooxanthellae. *C. gigantea* also feeds on large invertebrates and fish, using nematocysts on its tentacles to subdue prey (Barnes 1987).

C. gigantea may influence herbivory on turtle grass in a manner similar to *B. antillensis*. Several species of crabs and shrimp find refuge from fish predators beneath the tentacles of *C. gigantea*, suggesting that *C. gigantea* nematocysts may be potent enough to deter herbivores. If the interaction between *C. gigantea* and turtle grass is simi-

lar to that between turtle grass and *B. antillensis*, then herbivory should be lower for grass blades in contact with *C. gigantea* tentacles. This effect should be apparent both on exposed rock terrain (where isolated turtle grass may be more susceptible to herbivory) and in homogeneous fields of turtle grass.

METHODS

We conducted sampling in 1 - 2 m depth, low-wave-action water in the west back reef of Discovery Bay, Jamaica, from 25 - 26 February 2000. We collected turtle grass blades with no herbivory and similar epiphyte loads and made replicates consisting of 10 turtle grass blades each. To anchor blades in the field, two clothespins holding five blades apiece were attached with string to a 7 cm bolt; a plastic vial, serving as a buoy, was attached to each bolt via a 1 m long string. We used two treatments: in contact with an anemone (anemone) or 1 m from any anemone (control), on either rocky or sandy substrate. We completely crossed this design with five replicates per treatment. Rock replicates were placed

on rocky structures larger than 0.5 m²; sand replicates were placed in turtle grass at least 4 m from any visible rocks. Replicates were paired within substrate, with each control being placed 1 m from an anemone replicate. We retrieved each bolt approximately 24 h after initial placement.

We measured the proportion of each blade lost to herbivory and normalized the mean proportion lost for each replicate with an arcsine square-root transformation. We analyzed the effects of anemone and substrate type on the proportion of blade removed (herbivory) with a two-way, nested ANOVA (SAS 1997). We nested treatment pairs (anemone + control) within substrate to account for local differences in herbivory between the microhabitats of each pair.

RESULTS

We found no effect of either anemone, substrate, or their interaction on herbivory of turtle grass blades (Table 1; Fig. 1). In addition, there was no difference in herbivory on different treatment pairs nested within each substrate (Table 1). All herbivory on the turtle grass seemed due to parrotfish.

DISCUSSION

Contrary to our predictions, we found

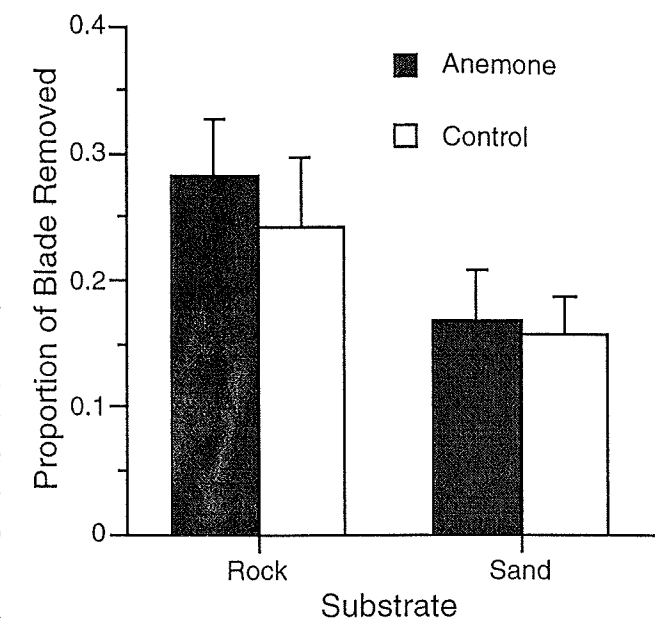


Fig. 1. Effects of anemone contact and substrate on herbivory levels (mean proportion \pm SE removed from blade) of turtlegrass during a 24 h period in the back reef of Discovery Bay, Jamaica. Anemone treatments were placed in contact with *C. gigantea*, with a control treatment placed 1 m from any anemone. Replicates consisted of 10 turtle grass blades, $n = 5$ for all treatment combinations.

that contact with *C. gigantea* did not affect turtle grass herbivory. *C. gigantea* nematocysts may not be potent enough to injure fish as large as parrotfish, the primary herbivore of turtle grass at Discovery Bay. Alternatively, as both experimental and natural turtle grass blades were on average, taller than *C. gigantea* tentacles, fish may be susceptible to the tentacles but still able to feed on the top portion

Table 1. Two-way analysis of variance testing the effects of anemone contact (*Condylactis gigantea* contact vs. control), substrate (rock vs. sand), anemone contact x substrate type, and treatment pairs (paired anemone and control at each location) nested within substrate on herbivory of *Thalassia testudinum* ($n = 5$ for all treatment combinations).

Source	Degrees of Freedom	Mean Squared Error	F-ratio	P > F
Anemone Contact	1	0.001	0.005	0.944
Substrate	1	0.000	0.000	0.989
Anemone Contact x Substrate	1	0.012	0.055	0.818
Treatment pairs [substrate]	2	0.007	0.032	0.968
Error	14	0.216	0.132	0.983

of grass blades without risking contact and injury from the tentacles. These results support those of a previous study that, despite having tested grass placed a full 30 cm from anemones, concluded that *C. gigantea* presence did not affect turtle grass herbivory (Babineau et al. 1999).

Our finding that substrate does not influence the level of herbivory suggests that the risk of herbivory does not play a major role in inhibiting turtle grass growth on rocks. Environmental factors, such as intense wave disturbance and lack of suitable substrate for germination and root establishment, are probably stronger determinants of low turtle grass recruitment on rocks.

Indirectly, *C. gigantea* may benefit from not creating a favorable microhabitat for turtle grass. *C. gigantea* naturally grows interspersed among turtle grass. The two species, therefore, compete for limited amounts of light. If *C. gigantea* sheltered turtle grass, grass growth rate and blade height would increase. Simultaneously, the light level penetrating to anemone tentacles would decrease. Without sufficient light, photosynthesis of *C. gigantea* zooxanthellae would diminish, thereby lowering anemone fitness. Conversely, if small fish are an important component of anemone diet and if turtle grass serves as a refuge for small fish, then the absence of grass or the presence of short, cropped grass proximate to an anemone would reduce the immediate prey density around, and decrease the foraging opportunities of, the anemone. Ultimately, *C. gigantea* must weigh the costs of shading with those of decreased prey availability; the relative benefits of obtaining nutrients from its zooxanthellae symbionts vs. capturing live prey lies delicately in the balance. *C. gigantea* and turtle grass coexistence suggests that species must sometimes tolerate sub-optimal growing conditions in order to maintain viable populations within the highly competitive coral reef ecosystem.

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